MINERνA

Main INjector ExpeRiment for ν-A

Active segmented scintillator detector: 5.87 tons

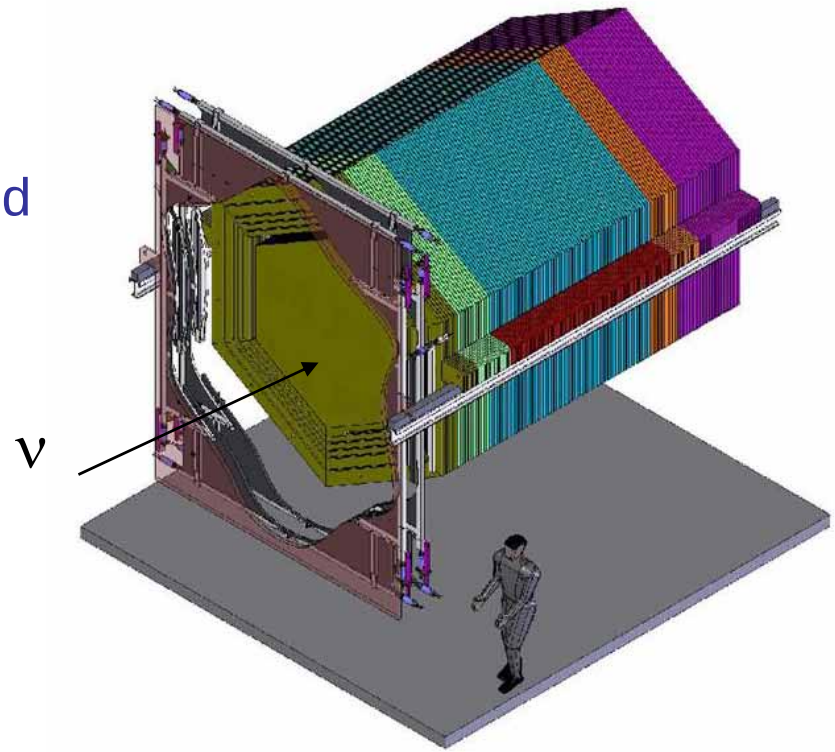
1 ton of US nuclear target planes (C, Fe, Pb)

Why MINERvA?

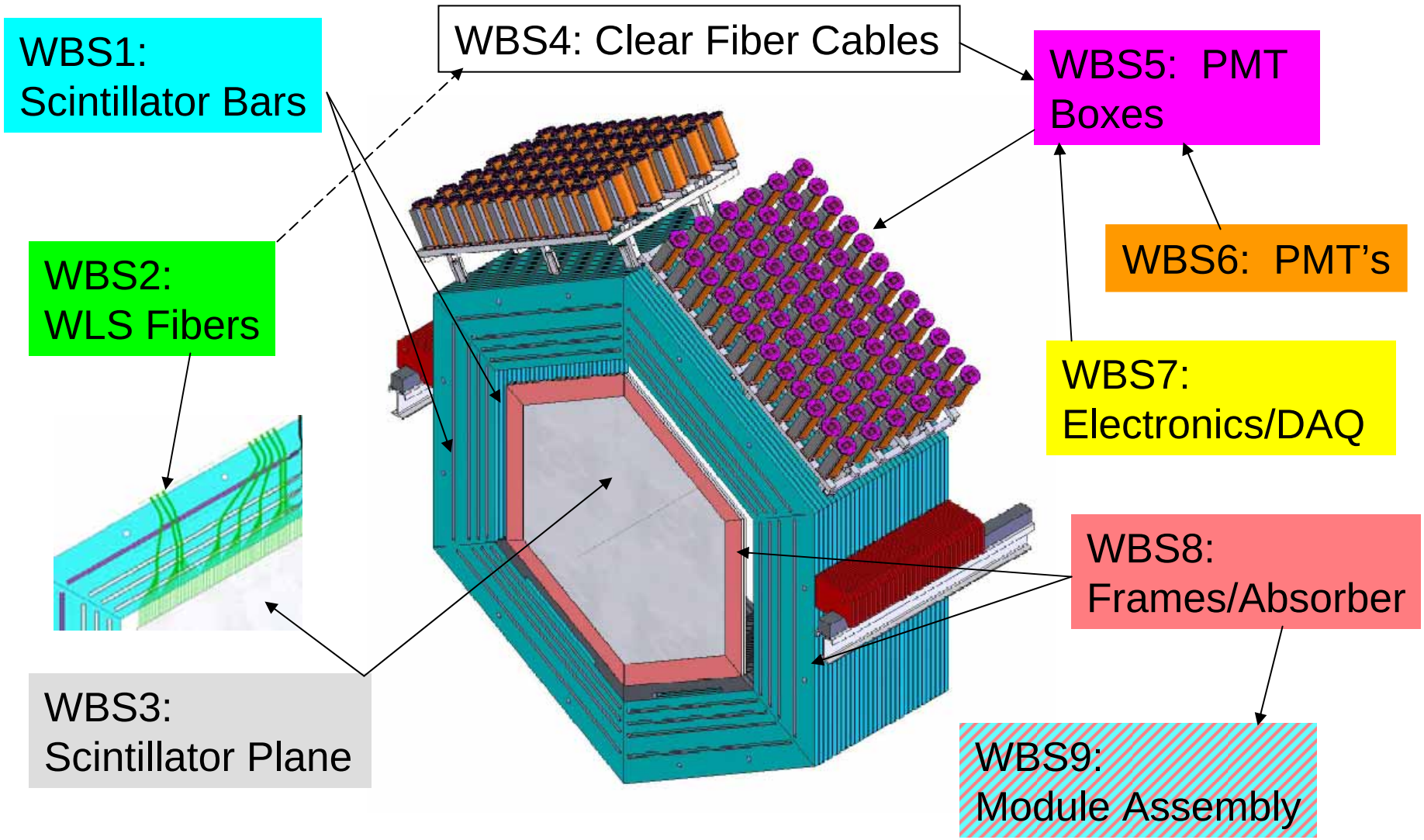
- MINER*v*A is a compact, fully active neutrino detector designed to study neutrino-nucleus interactions with unprecedented detail
- The detector will be placed in the NuMI beam line upstream of the MINOS Near Detector
- MINERvA is unique in worldwide program
  - The NuMI intensity provides
    - Opportunity for precision neutrino interaction measurements
    - Wide range of neutrino energies
  - Detector with several different nuclear targets allows 1st study of neutrino nuclear effects
  - Crucial input to current and future oscillation measurements
- Stage 1 Approval April 2004
- First Director's Review January 2005
- CD0 recently (CD-1/CD-2 DOE Review early next summer)
- Director's Review Dec 13-15 (another one in the spring)

Basic Detector

- MINER*v*A proposes to build a low-risk detector with simple, well-understood technology
- Active core is segmented solid scintillator
  - Tracking (including low momentum recoil protons)
  - Particle identification
  - 3 ns (RMS) per hit timing (track direction, identify stopped $K\pm$)
- Core surrounded by electromagnetic and hadronic calorimeters
  - Photon (π^0) & hadron energy measurement
- MINOS Near Detector as muon catcher



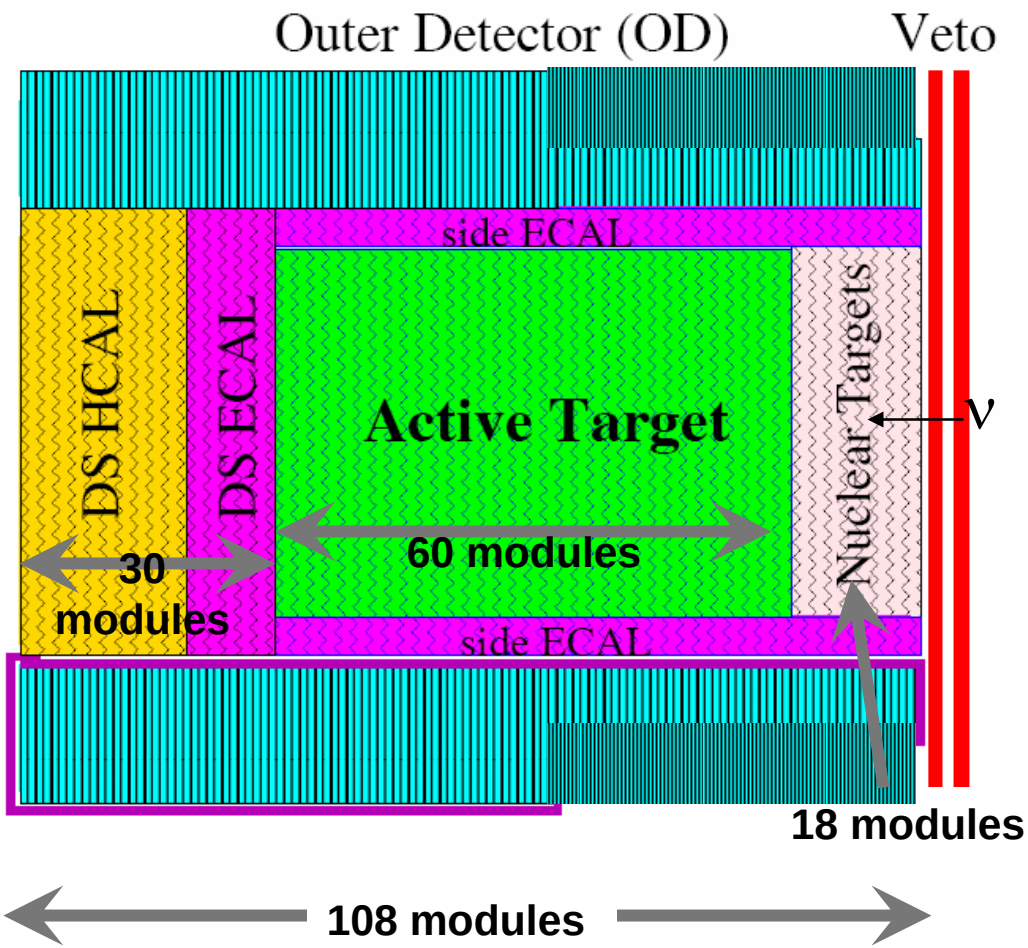
Overview of MINERvA Detector



WBS & Universities

1 Scintillator Extrusion - Anna Pla-Dalmau (FNAL, NIU, PI Victor Rykalin)
2 WLS Fibers – Howard Budd (Rochester, PI Kevin McFarland)
3 Scintillator Plane Assembly – Jeff Nelson (William& Mary, also Hampton University PI Cynthia Keppel)
4. Clear Fiber Cables – Howard Budd (Rochester, PI Kevin McFarland)
5 PMT Boxes – Tony Mann (Tufts, also Rutgers PI Ron Ransome)
6 PMT Procurement & Testing – Ioana Niculescu (James Madison University) and George Tzanakos (University of Athens, Greece)
7 Electronics & DAQ – Dave Casper (Univ. Ca. Irvine, also University of Pittsburg PI Vittorio Paolone)
8 Frame, Absorbers & Stand – Jim Kilmer (FNAL)
9 Module Assembly & Installation – Jim Kilmer (FNAL), Bob Bradford (Rochester PI Kevin McFarland)
10 Project Management – Debbie Harris (FNAL)

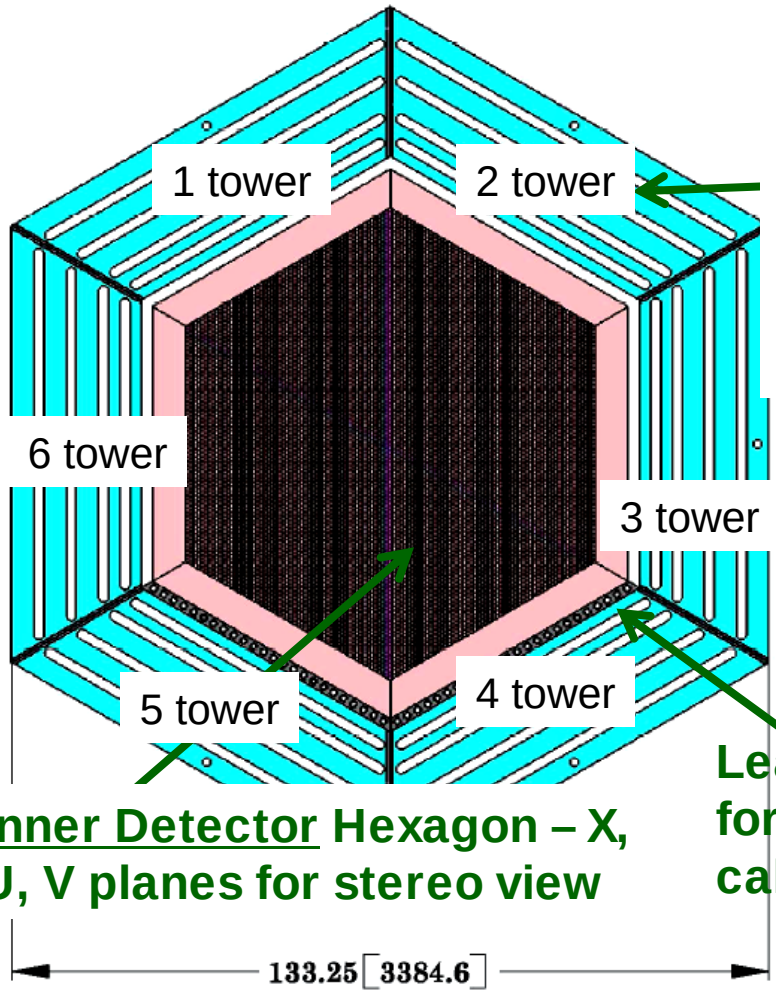
Basic Detector Geometry



	Module/Frame	Scintillator Planes
Nuclear Targets	18	36
Active Target	60	120
DS ECAL	10	20
DS HCAL	20	20
Totals	108	196

- Downstream Calorimeter: 20 modules, 2% active, sheets of lead (ECAL) or steel (HCAL) between scintillator planes
- 2 thin lead "rings" for side ECAL

MINERvA Detector Plane



Outer Detector (OD) Layers of iron/scintillator for hadron calorimetry: 6 Towers

Inner Detector Hexagon – X, U, V planes for stereo view

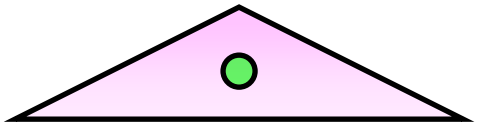
Lead Sheets for EM calorimetry

- **30,272 channels**
  - 80% in inner hexagon
  - 20% in Outer detector
- **473 M-64 PMTs** (64 channels)
- **1 wave length shifting fiber per scintillator**, which transitions to a clear fiber and then to the PMT
- **128 pieces of scintillator per Inner Detector plane**
- **8 pieces of scintillator per Outer Detector tower, 6 OD detector towers per plane**

MINERvA Optics

(Inner detector scintillator and optics shown, Outer Detector has similar optics but rectangular scintillator)

Scintillator



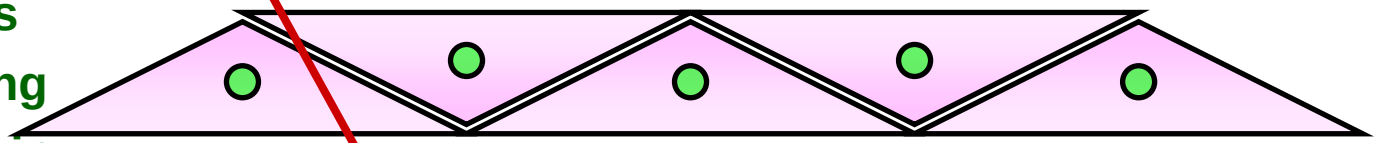
1.7 × 3.3 cm² strips

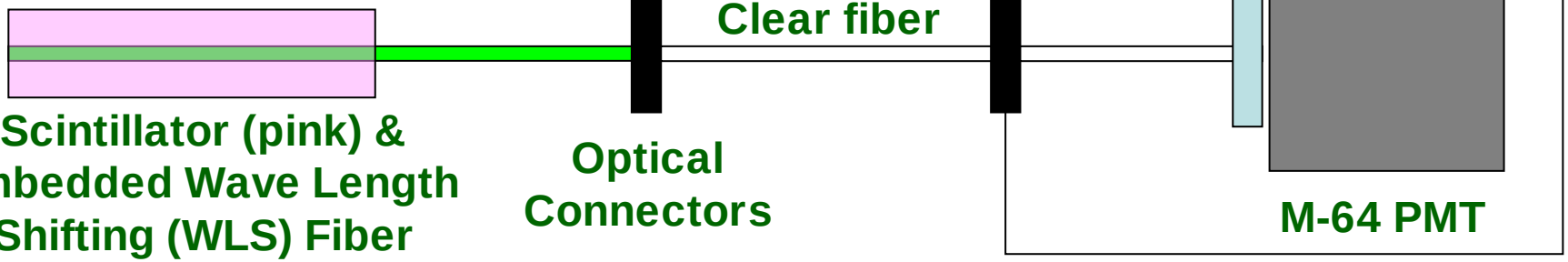
Wave Length Shifting (WLS) fiber readout in center hole

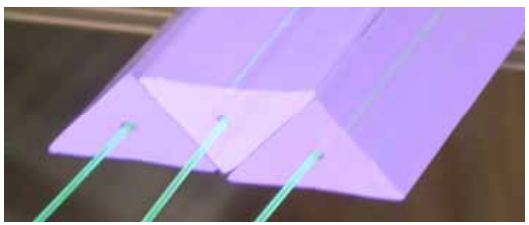
Particle

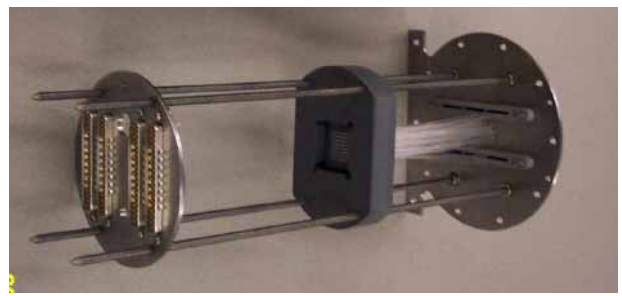
For the Inner Detector, scintillator is assembled into 128 strip scintillator planes

Position determined by charge sharing



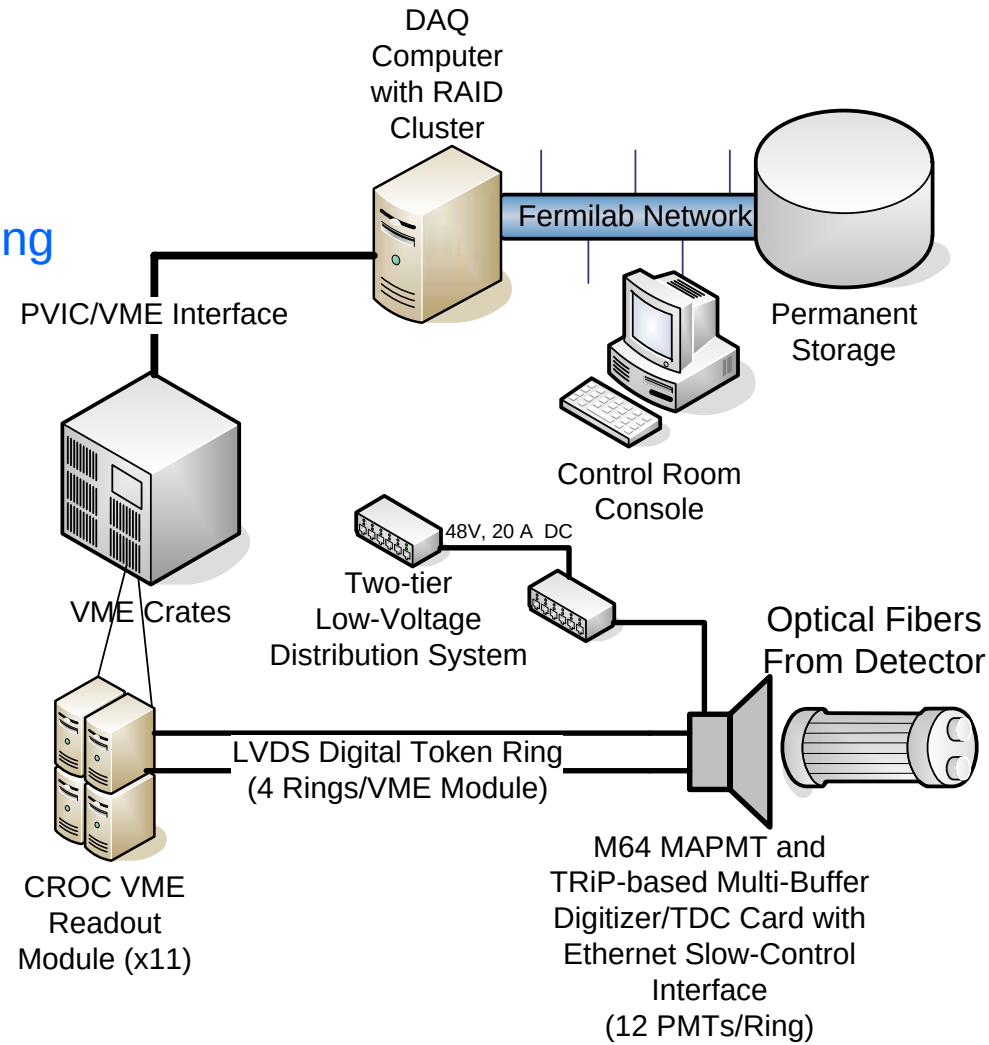






MINERvA Electronics

- **Front End Boards**
  - One board per PMT
  - High Voltage (700-800V)
  - Digitization via Trip Chips, taking advantage of D0 design work
  - Timing
- **CROC Boards and DAQ**
  - One board per 48 PMT's
  - Front-end/computer interface
  - Distribute trigger and synchronization
  - 3 VME crates & one DAQ computer
- **Power and rack protection**
  - Uses 48V power
  - 7kW needed



Highlights of each Fiscal Year

- **FY06-FY07: R&D and Assembly and Testing Process Prototyping**
  - Make co-extruded scintillator and test
  - R&D on making bulk clear fiber cables
  - WLS fiber qualification and prototypes
  - Scintillator Plane assembly R&D, prototype plane and module assembly
  - PMT box assembly R&D and prototypes
  - Electronics R&D continues: Front-End board, CROC module
  - PMT testing and alignment procedures defined and tested
  - Outer Detector frame prototypes and Module assembly R&D
  - *20 Module Prototype constructed in FY07*
- **FY08: construction begins**
  - Remaining R&D: mostly electronics design
  - Bulk purchases: PMT's, WLS fiber, Clear fiber, PMT box components, steel and lead purchases
- **FY09: complete construction, begin installation**
  - Buy LV system, remaining PMT's, install detector stand, modules, PMT boxes, electronics, cables

Overview of Work by Fund Types

- R&D Includes all design work and prototyping:
  - Scintillator and fiber prototyping and testing
  - Preliminary purchase of 10 PMTs to determine necessary specifications for bulk purchase and to understand bulk testing procedures
  - Two electronics & DAQ systems for prototyping and testing PMTs
  - One full module prototype (from scintillator through DAQ and module mapper)
  - Prototype Detector Stand
- MIE Includes:
  - Construction of Detector proper and currently some spares
- Installation & Infrastructure Includes:
  - Installation tasks in the MINOS Hall
  - Generic infrastructure costs that would be necessary for any future experiment in the NuMI near hall (power panels, cooling, etc.)

Organization Chart